Instruction Manual

DS09

Angle seat variable area flowmeter

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Table of Contents

Safety Information

General Instructions

To ensure safe operation, the device should only be operated according to the specifications in the instruction manual. The requisite Health & Safety regulations for a given application must also be observed. This statement also applies to the use of accessories. Every person who is commissioned with the initiation or operation of this device must have read and understood the operating instructions and in particular the safety instructions!

The liability of the manufacturer expires in the event of damage due to improper use, non-observance of this operating manual, use of insufficiently qualified personnel and unauthorized modification of the device.

Proper Usage

Series DS09 angle seat variable flow meters are designed to measure and monitor continuous flow rates of liquids and gases which do not attack the device materials. All other usage is regarded as being improper and outside the scope of the device.

In particular, applications in which shock loads occur (for example, pulsed operation) should be discussed and checked in advance with our technical staff.

The series DS09 flow meter devices should not be deployed as the sole agents to prevent dangerous conditions occurring in plant or machinery. Machinery and plant need to be designed in such a manner that faulty conditions and malfunctions do not arise that could pose a safety risk for operators.

Dangerous substances

For dangerous media such as e.g. Oxygen, Acetylene, flammable or toxic substances as well as refrigeration systems, compressors, etc. must comply with the relevant regulations beyond the general rules.

Qualified Personnel

The DS09 devices may only be installed by trained, qualified personnel who are able to mount the devices correctly. Qualified personnel are persons, who are familiar with assembling, installation, placing in service and operating these devices and who are suitably trained and qualified.

Inward Monitoring

Please check directly after delivery the device for any transport damages and deficiencies. Additional with reference to the accompanying delivery note the number of parts must be checked.
Claims for replacement or goods which relate to transport damage can only be considered valid if the delivery company is notified without delay.

Functional Description

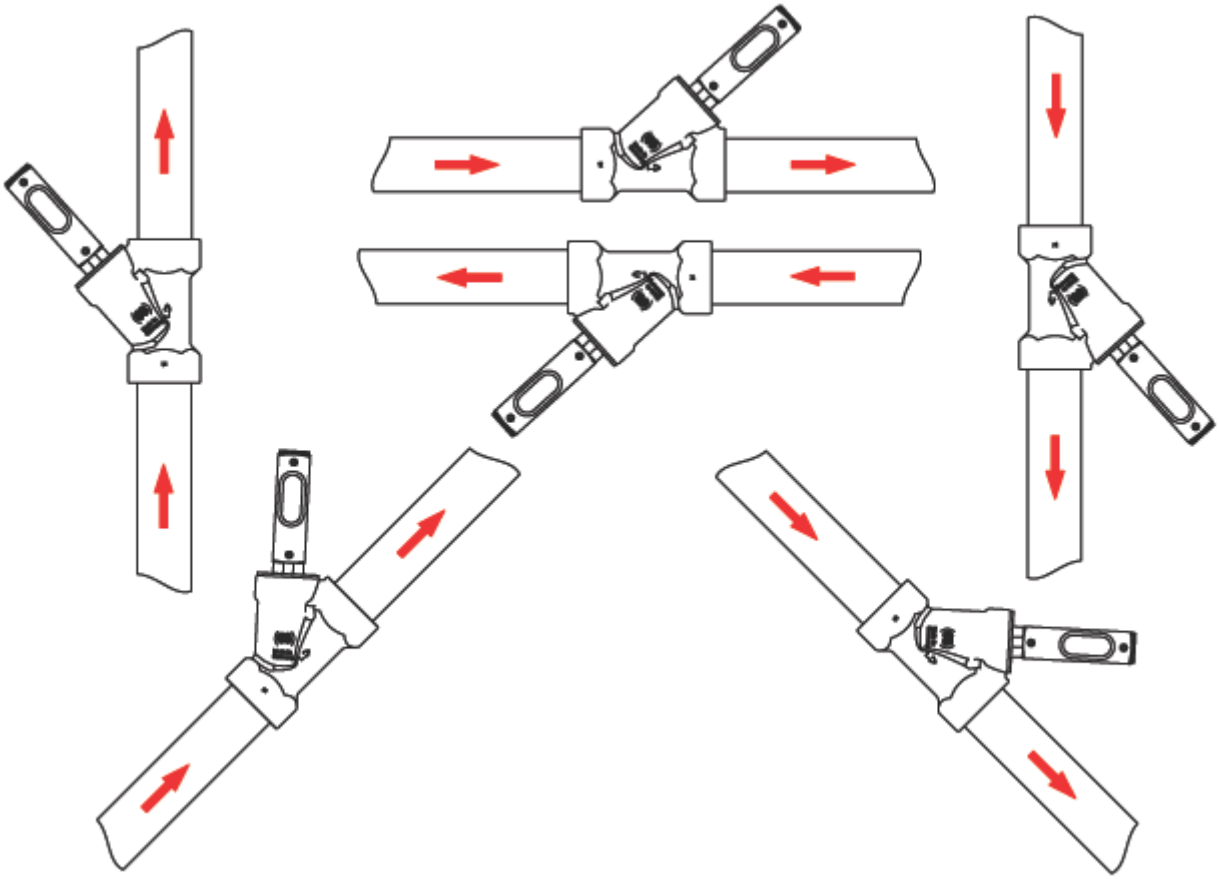
DS09 flow monitors operate on the principle of the variable area flowmeter. The flow monitor is installed into a pipe system and measures the flow rate of the medium flowing through the pipe
system.
A float inside the flow monitor is moved by the flowing medium. Together with the float, the flow indicator inside the sight glass is moved. A magnetic field is generated by the magnets integrated in the flow indicator. The position of the float is detected by the switch contact.
In addition to electrical control through the Reed-contact (switch contact), the current flow rate can also be read-off on the measuring scale on the sight glass.
Applications for DS09 flow monitors are, for example, cooling circuits. The device monitors the volume flow of the cooling media to ensure sufficient cooling. If the flow through the flow monitor drops below the threshold preset by the operator, the switch contact switches (change-over contact) or opens (normally open contact).

Design

1 Venting screw
2 Device housing
3 Spring
4 Sight glass with measuring scale
5 Flow indicator
6 Process connection
7 Switch contact with socket or connection cable
8 Media inlet
9 Media outlet
10 Primary flow unit

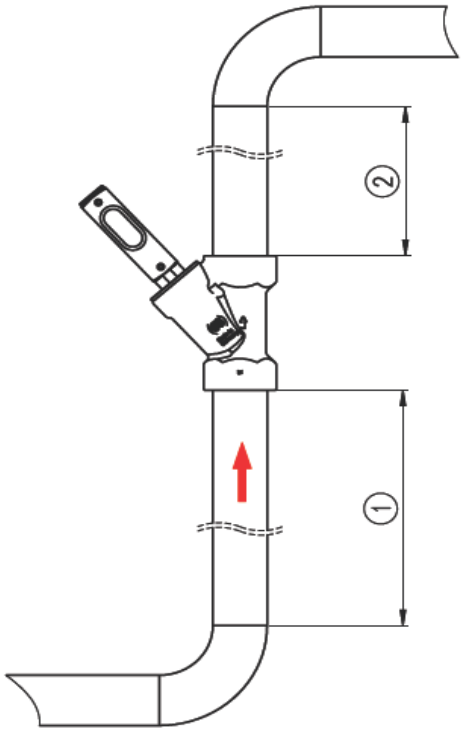
- Do not use the flow monitor with quick-acting valves
- Do not use the flow monitor with solenoid valves
- Do not subject the flow monitor to vibrations
- Do not subject the flow monitor to pressure surges
- Do not use the flow monitor with media containing solids or abrasives
- Use the flow monitor only with media previously approved by the manufacturer
- Do not use the flow monitor as the sole monitoring device to prevent dangerous conditions
- Do not install the flow monitor as a load bearing part within a pipeline system
- The flow monitor with sight glass must be installed in such a way as to preclude damage to the sight glass by outside force. If necessary, install an appropriate impact protection device.
- External magnetic fields will influence the switch contact. Keep sufficient distance to magnetic fields (e.g. electric motors).
- Piping, process connections or supports made of ferromagnetic material influence the magnetic field of the device. Keep a space of minimum 100mm to those materials (e.g. steel).
- Ensure that there are no foreign particles in the device
- Ensure that the device is not soiled
- Do not use any medium containing solids

Installation position/direction of flow:



The flow monitor must only be installed in one of the positions displayed above. The medium must flow in the direction of the arrow (from a low to a high scale value).

Measuring inaccuracy due to incorrect installation!



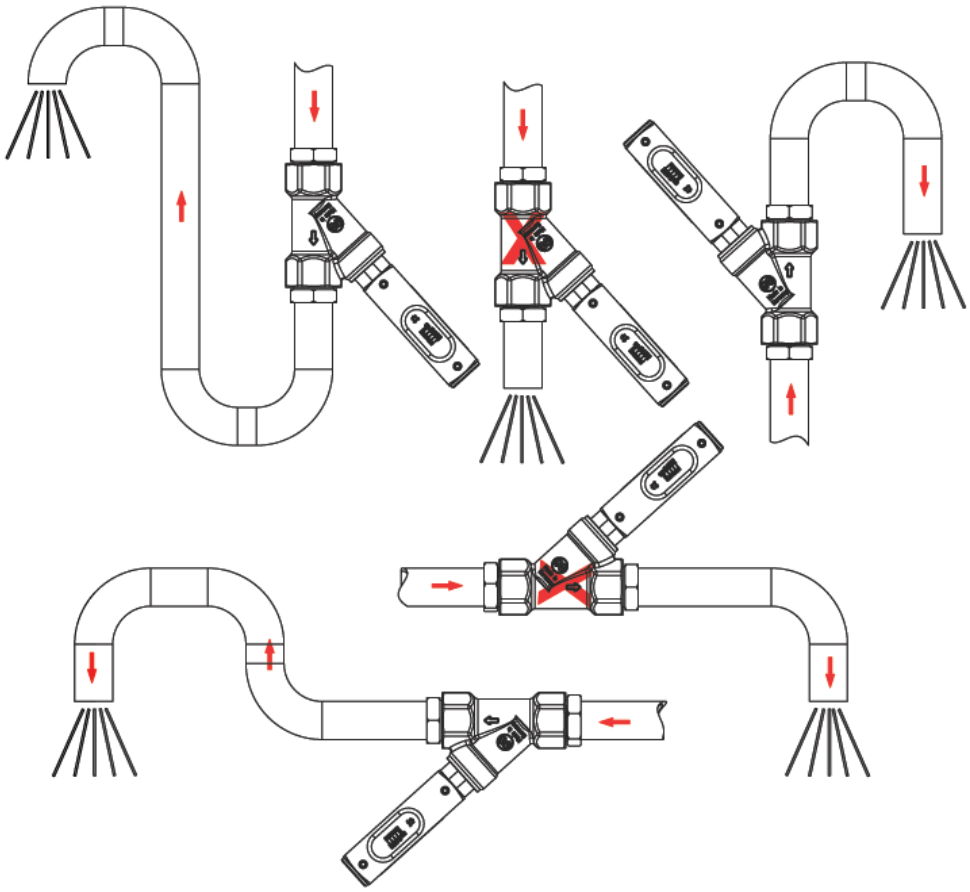
The measuring accuracy of the flow monitor is influenced by its position within the pipe system.
Changes in cross-section, branchoffs or bends in the pipe system impair measuring accuracy.
– Ensure that the unimpeded flow sections are maintained
– Never reduce the pipe diameter immediately before the device

Unimpeded flow sections

An unimpeded flow section of 10xDN (rated width) must be maintained before the device.
An unimpeded flow section of 5xDN (rated width) must be maintained after the device.

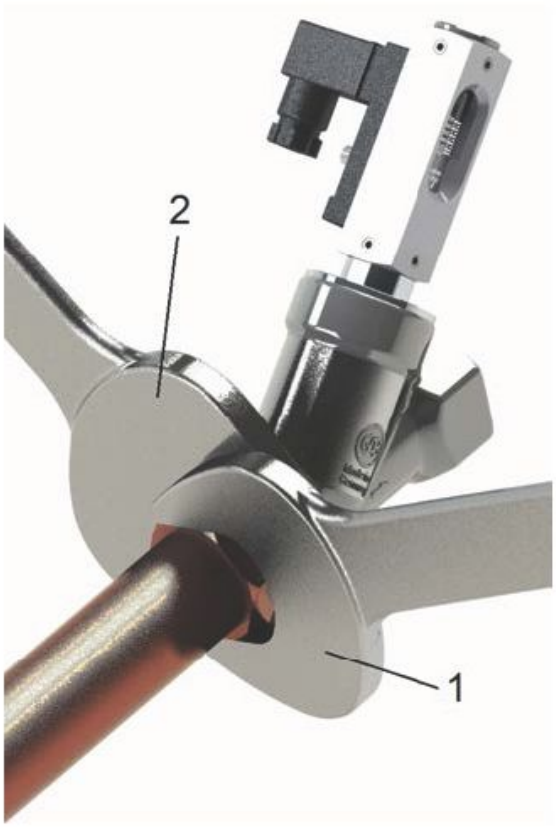
Unimpeded outlet

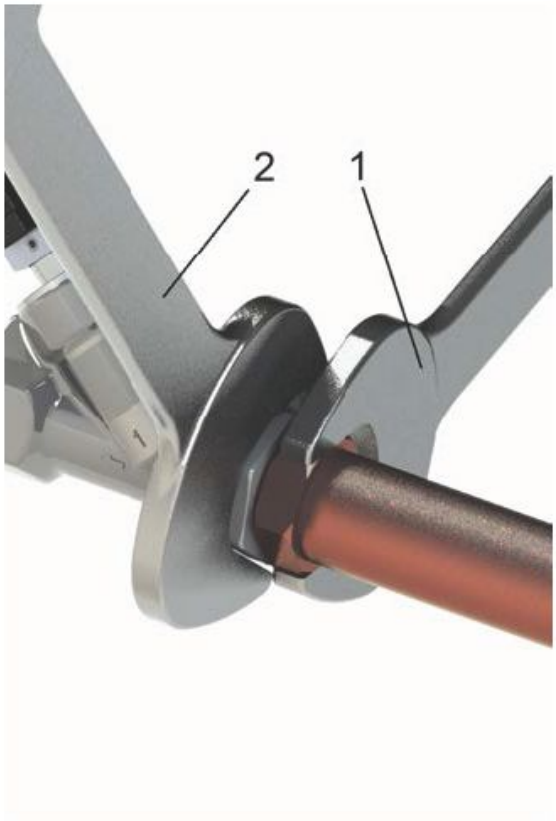
If the pipe system ends at an unimpeded outlet, the flow monitor must not be installed directly in front of the opening. The device must always be completely filled with media to ensure measuring accuracy.



Installation

1. Place the threaded end of the device onto the thread of the connecting pipe
2. Fasten the adapter union of the pipeline with a suitable spanner (1). When doing so, lock the process connection of the device in place to prevent slip, using a suitable spanner (2).
3. Keep turning in the adapter union (1) while holding the process connection of the device locked (2) until the connection is tight.
4. Repeat these steps at the other end of the device.





Initial Startup

The following steps must be taken before initial startup and any subsequent startup (e.g. after removal and installation during maintenance).

- Make sure that the plant is operating vibration-free. Vibrations could destroy the device.
- Make sure that the medium is flowing continuously. Pulse-like staggered loads could destroy the device.
- Completely fill the pipelines. Partial filling(s) may result in malfunctions and damage to the device.
- Vent the pipeline. If there are air bubbles in the line during the measurement, this could result in damage to the device caused by hydraulic shock. This may cause malfunctions.
- Make sure that the plant is operating without cavitation. Cavitation may result in malfunctions and damage to the device.

Tightening Torque

Component/ function	Description	Size	Torque	Qty
Device housing screw	Hex head screw	M4x4	1,0 Nm	8
Switch contact housing screw	Hex head cylinder screw	M3x10	0,4 Nm	1
Venting screw	Hex head threaded pin	M6x8	2 Nm	1
Process connection, primary flow unit and device housing	Process connection DN15/ DN25	SW19	20 Nm	1

Electrical Connection

The electrical connection of the flow monitor is via the connector plug. The switch contacts employed in these devices are potential free and do not require a power source. Switch contacts and flow monitor have been optimally harmonized. After replacement of a switch contact, the switch point must be readjusted.

Attention: Prior to the electrical connection of the device, it must be ensured that the supply voltage matches that required and the supply voltage is switched off.

Switch contact with connector in compliance with EN175301-803, form C

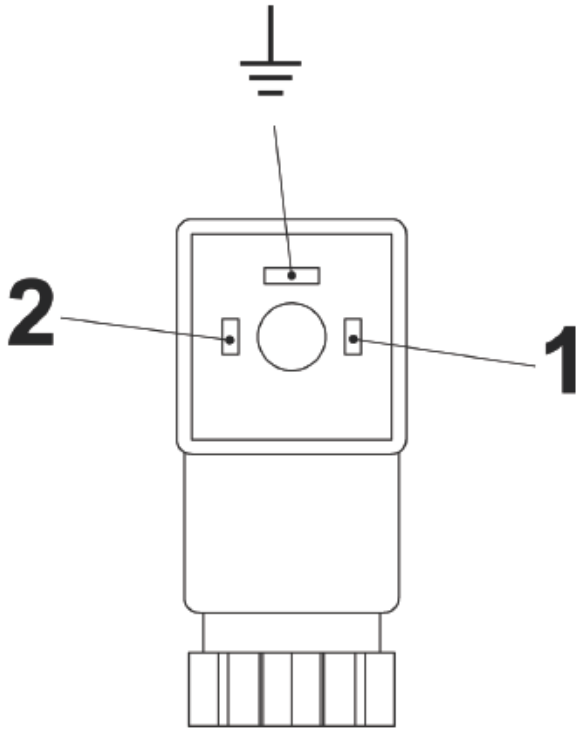
Switch position under no-flow condition:

Normally Open (NOC)

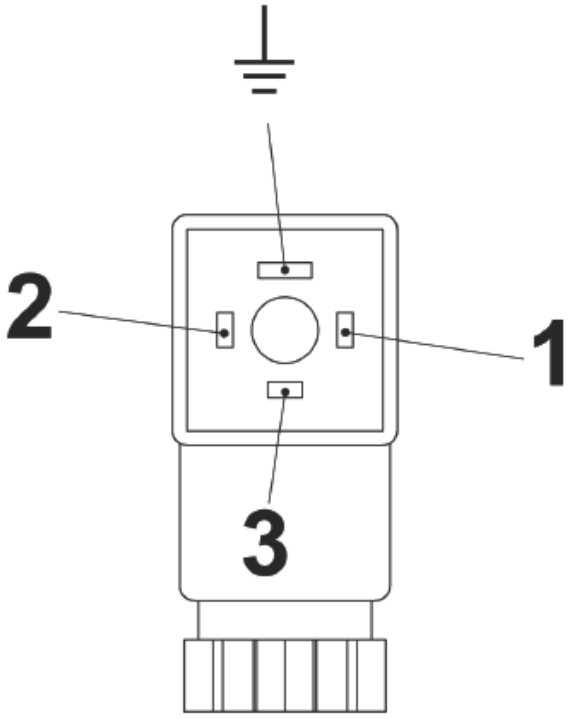
Change Over (COC)

Pin assignment plug socket (the ground-pin is not used)

Normally Open (NOC)



Change Over (COC)



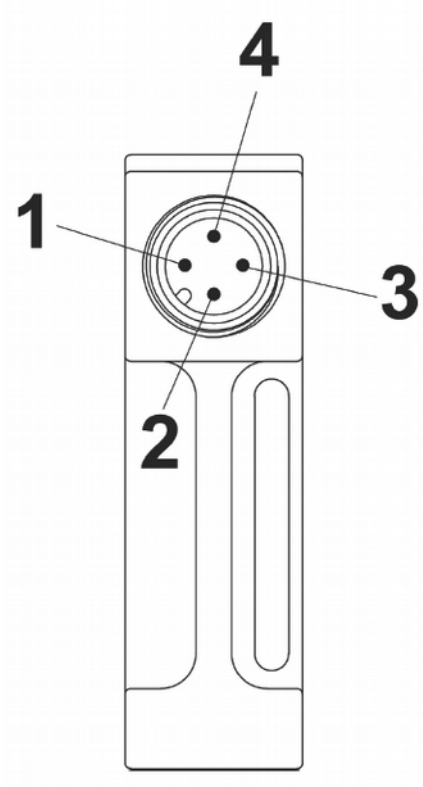
Switch contact, plug connector M12x1

Switch position under no-flow condition:

Normally Open (NOC)

Change Over (COC)

Pin assignment M12x1 plug connection



Grounding the device

When installing the device in a pipe system, ensure that the device is grounded to the pipe system to avoid a dangerous electrical potential difference.

Contact Protection Measures

Reed switches are basically designed for small contact ratings. To connect a load with higher power consumption it is indispensable to use a contact protection relay (e.g. our series MSR01)
If you connect directly a load to a Reed contact the following recommendations should be considered.
None of the contact rating values printed on the switching unit must not to be exceeded, even momentarily. This is valid for each of the given values individually: voltage, current, power. The Reed contact integrated in the switching unit is very sensible to electrical overload

Danger of overload is given by the following applications:

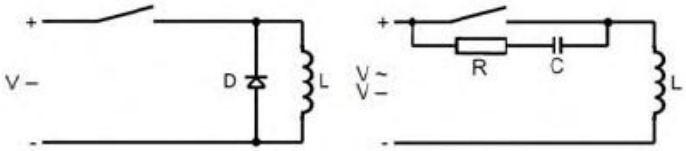
- inductive load
- capacitive load
- lamp load

Inductive Load

Inductive loads consist e.g. of relay, contactors, solenoid valves, motors, electric engines, etc.

⚠WARNING: Voltage spikes at shut down (up to 10 times of nominal voltage)

Protective measures: (examples)



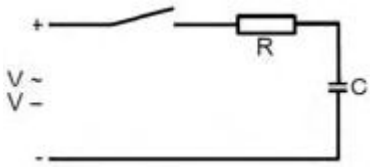
(Flyback diode, e.g. type 1N4007)

Capacitive Load

Capacitive loads consist e.g. of long connection cables or capacitive consumers.

⚠WARNING: High current spikes at switching on (this will exceed the nominal current)

Protective measures: (examples)



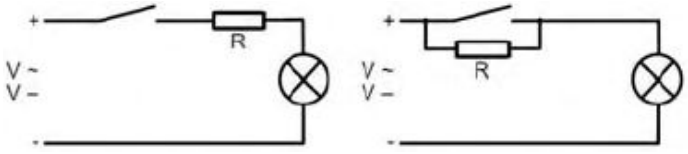
Limitation of current by a resistor

Lamp Load

Lamp loads consist e.g. by light bulbs, starting motors .

⚠WARNING: High current spikes at switching on, because the glowing spiral has low resistance at low temperature.

Protective measures: (examples)



Limitation of current by a resistor or preheating of the glowing spiral.

Connecting to a PLC

There is no need for protective measures by connecting the Reed switch to a PLC. The Reed contacts are plated by Tunsten, Gold, and Rhodium located in a protective atmosphere. They can be directly connected to the input terminals of a PLC without problems.

RC-Circuits as protective measures (Boucherot cell, Snubber)

In practice the following values of resistor/capacitor cells give good results. Nevertheless, the values given in the following tables are only recommendations for general purposes. But it cannot be guaranteed that for specific applications more adequate Boucherot cells may exist.

For Reed switches of 10 – 40 VA

Voltage [V]	Resistance [Ohm]	Capacitance [nF]
230	1500	330
115	470	330
48	220	330
24	100	330

For Reed switches of 40 – 100 VA

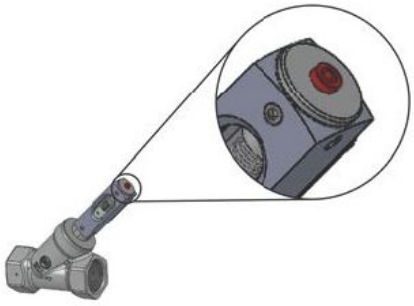
Voltage [V]	Resistance [Ohm]	Capacitance [nF]
230	1000	330
115	470	330
48	100	330
24	47	330

Venting the Valve

If air bubbles are present in the piping system during the measurement, the pipeline must be vented.

WARNING!
Risk of injury from uncontrolled release of media! If the threaded pin is opened too far, the media will escape uncontrolled.

1. Using a hex screwdriver, loosen the threaded pin 3 turns.
   The air bubbles in the pipe system escape.
2. Tighten the threded pin, observing the correct tightening torque for the threaded pin

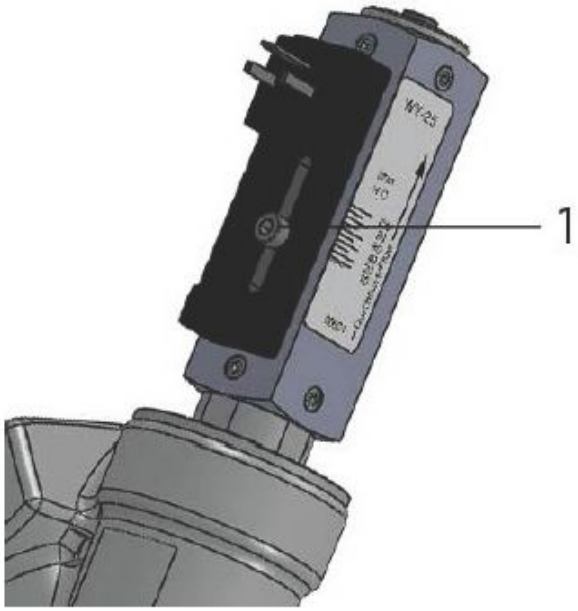


Threaded pin for venting

Setting the Switch Point

The following instructions describe the procedure for a Normally Open Contact (NOC). The actual state (open or closed), can be determined using a continuity meter.

1. Loosen the set screw of the switch contact (1) using a hex screwdriver.
2. Slide the switch contact to the point that corresponds to the flow rate to be monitored. Ensure that the positioning arrow on the switch contact adhesive label is aligned with the desired flow rate on the switch point adjustment scale.
3. Tighten the set screw of the switch contact, using a hex screwdriver. When doing so, observe the correct tightening torque of the screw.



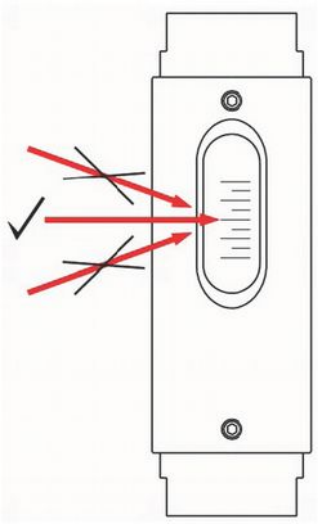
The set switch point corresponds to the switch-off point of the switch contact by decreasing flow.

Checking / Reading-off the Flow

1. The top edge of the float is the read-off point

2. To obtain greatest reading accuracy, read-off at eye level. The readoff value can be falsified by viewing at an angle

3. Read-off the flow value from the measuring scale

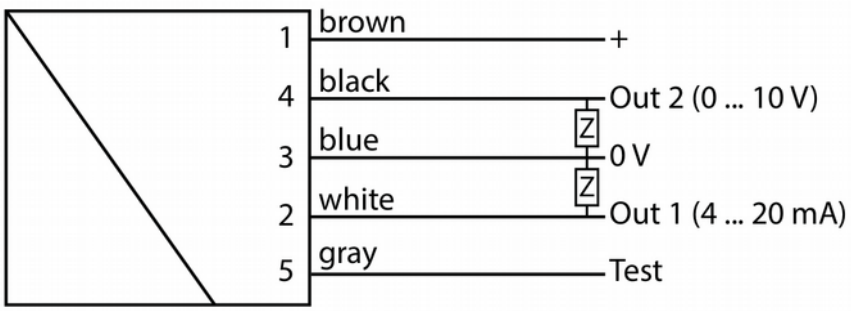


Electrical connection of analogue transmitter SU20

Attention:

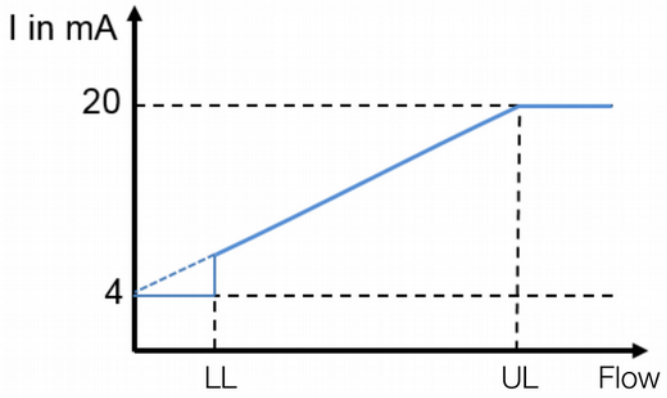
We recommend using only shielded connection cables.
The units are equipped with an integrated electronic unit and are ready for operation immediately after installation and connection.
Pin 5 must not be contacted electrically! Ideally, use a 4-pole cable.
Before connecting the unit electrically, make sure that the supply voltage matches the required one: 24 V_{DC} (19...30 V_{DC}).
Before connecting the unit electrically, the supply voltage must be switched off.
The analogue output is factory-set to the specified measuring range.

Connection:

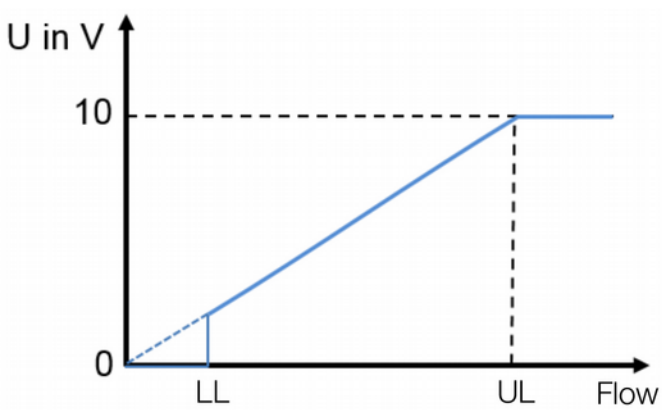


Characteristics:

Current-Flow characteristic:



Voltage-Flow characteristic:



LL: lower limit of measuring range
UL: upper limit of measuring range

Operating conditions:

Operating temperature: -20...+70 °C
Storage temperature: -20...+80 °C
Accuracy*: ± 1 % of full scale
*The actual accuracy depends on the flow sensor used

Fault description	Cause	Remedy	Personnel
The switch contact does not switch.	No medium flowing through flow monitor	Check that medium is flowing through the pipe-line	Qualified personnel
	Flow is too low or the switch contact is set too high	■ Adjust the switch contact to a lower flow rate ■ Use the device at another measuring range ■ Increase the flow rate	Qualified personnel
	Incorrect reduction fitting or pipe diameter is too small	■ Correct pipe diameter	Qualified personnel
	Float is stuck	Disassemble and clean the device	Qualified personnel
	Switch contact is defective.	■ Remedy the cause of the defect (short-circuit, overload) ■ Replace the switch contact	Qualified personnel
Switch contact is permanently switched.	Flow is too high or the switch contact is set too low	■ Reduce the flow ■ Adjust the switch contact to a higher flow rate ■ Use the device at another measuring range	Qualified personnel

Fault description	Cause	Remedy	Personnel
	Float is stuck	Disassemble and clean the device	Qualified personnel
	Switch contact is defective	■ Remedy the cause of the defect (short-circuit, overload) ■ Replace the switch contact	Qualified personnel
The switch point is not the same as the actual flow rate.	Improper scale installed for media used	Request proper conversion table or scale for media used	Qualified personnel
	Incorrect reduction fitting or pipe diameter is too small	■ Correct pipe diameter	Qualified personnel
	Device is dirty	Disassemble and clean the device	Qualified personnel
	Device is defective	Remove device from system and contact the manufacturer	Qualified personnel

DS09

Angle Seat Variable Area Flow Meter

- **high measuring range spans: 2,5...25 l/min and 10...100 l/min**
- **can be replaced without complete dismantling due to angled seat**
- **any mounting position without recalibration**
- **compact design even for high flow rates**
- **high switching accuracy**
- **made of brass (nickel plated)**
- **analogue transmitter 4...20 mA optional**
- **P_{max}: 10 bar, T_{max}: 100 °C**

Description:

The flowmeter and switch model DS09 works according to a modified variable area principle. The float is guided by the flowing medium into an angled seat measuring chamber. Together with the float, the flow indicator, in which a magnet is integrated, is also moved.
A reed contact or an analogue transmitter can be mounted outside the device. The reed contact is encapsulated in a continuously adjustable housing and thus protected from external influences.
When the float reaches the position of the Reed contact the switch will close. With higher flows the float moves further upward until it reaches a built-in float stop, still keeping the switch closed. This ensures a bistable switch function at any time. The Reed contact is adjustable over the full switching range of the meter.

Mounting position and functional reliability:

The device can be used in any mounting position by installing a spring which pushes the float back into its initial position against the flow.
The spring force and magnetic float guarantee absolute functional reliability.
Due to the angled seat of the measuring chamber, the device can be removed for maintenance work without complete removal. In addition, the angled seat ensures a large flow rate in a small space.

Typical application:

The DS09 variable area flowmeters and monitors are used to measure and monitor low-viscosity liquids in the following areas:

Cooling systems, mechanical engineering, medical technology, research and development

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Models:

Connection / measuring range:

G ½ female, 2,5...25 l/min water
G 1 female, 10...100 l/min water

(referenced to 1,013 bar abs, 20 °C, medium density 1,0 kg/dm³, vertical installation, flow from button to top)

Technical Data:

Max. pressure:	10 bar
Pressure loss:	ca. 0,3 bar
Max. media temperature:	100 °C
Accuracy:	± 10 % of FS (referenced to 1,013 bar abs, 20 °C, density 1,0 kg/dm³, vertical mounting, flow from button to top)
Electr. connection:	angle plug acc. to EN 175301-803, form C (DIN 43650) round plug M12 x 1 acc. to EN 50044,
optional:	angle plug with LED or glow lamp (on request)
Protection class:	IP65

Materials:

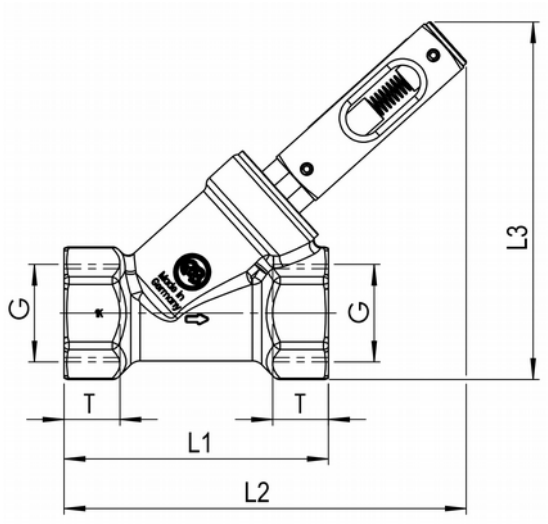
Protective housing:
(non-wetted parts) aluminium anodized

Wetted parts:

Float:	PEEK (DS09.15) brass (DS09.25)
Spring:	stainless steel 1.4571
Sight glass:	borosilicate glass
Gaskets:	NBR, optional FKM, EPDM
Magnet:	ferrite

all other wetted parts: brass, nickel plated

Dimensions:



Order Code:

Order Code:	DS09.	15.	1.	1.	C.	0

Angle seat variable area flow meter

Connection / Measuring range:
15 = G ½ female, 2,5...25 l/min water
25 = G 1 female, 10...100 l/min water

Material:
1 = brass nickel plated

Contact function / analogue output:
0 = without
1 = 1 N/O
2 = 1 SPDT
SU20 = analogue transmitter 4...20 mA and 0...10 V

Electrical connection:
0 = without
C = angle plug DIN 43650, Form C
(not with analogue transmitter)
M12 = round plug M12 x 1 (Tmax. 85 °C)

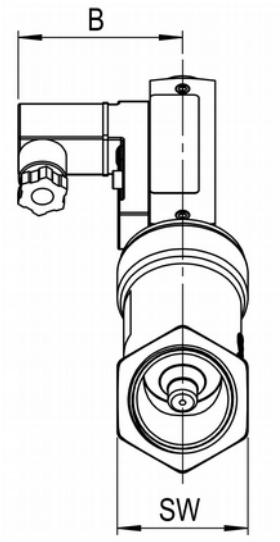
Options:
0 = without
1 = please specify in plain text

Contacts:

The contact opens/changes, if the flow level has fallen under the adjusted value

Switching capacity:

Contact function	Angle plug	M12x1 plug
1 = N/O	140 VAC, 0,7 A, 20 VA 200 VDC, 1 A, 20 VA	125 VAC, 0,7 A, 20 VA 125 VDC, 1 A, 20 VA
2 = SPDT	150 VAC/DC, 1 A, 20 VA	125 VAC/DC, 1 A, 20 VA



Dimension table:

Type	Dimensions [mm]						Weight
	SW	L1	L2	L3	T	B	[g]
DS09.15	27	65	117	101	14	50	300
DS09.25	41	90	137	122	19	50	700

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Analogue Transmitter SU20:

The position of a magnetic float / piston is detected by means of Hall sensors and converted into an analogue signal. .

- **analogue signal 4...20 mA and 0...10 V**
- **operating temperature: -20... +70 °C**
- **accuracy: +/- 10 % of full scale**
- **Aluminium housing, anodized**

Technical Data:

Accuracy*:	+/- 1 % of full scale
Operating temperature:	-20…+70 °C
Storage temperature:	-20...+80 °C
Repeatability:	tbd.
Housing material:	Aluminium, blue anodized
Protection class:	IP67

* The actual accuracy depends on the flow sensor used. On request the accuracy of the flow sensor used can be significantly increased by a customized calibration.

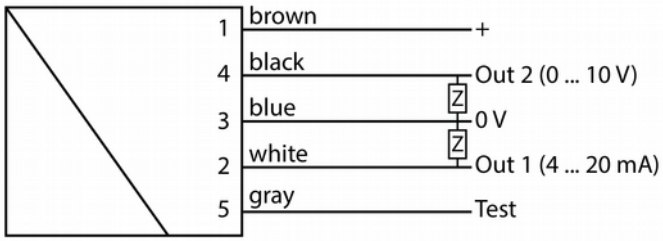
Electrical Data:

Analogue output:	4...20 mA and 0...10 V
Power supply:	24 V_{CD} (19...30 V_{DC})
Power consumption:	< 1 W
Current output:	max. load 600 Ohm
Voltage output	max. current 10 mA
Connection:	round plug M12x1, 5-pole

Notes:

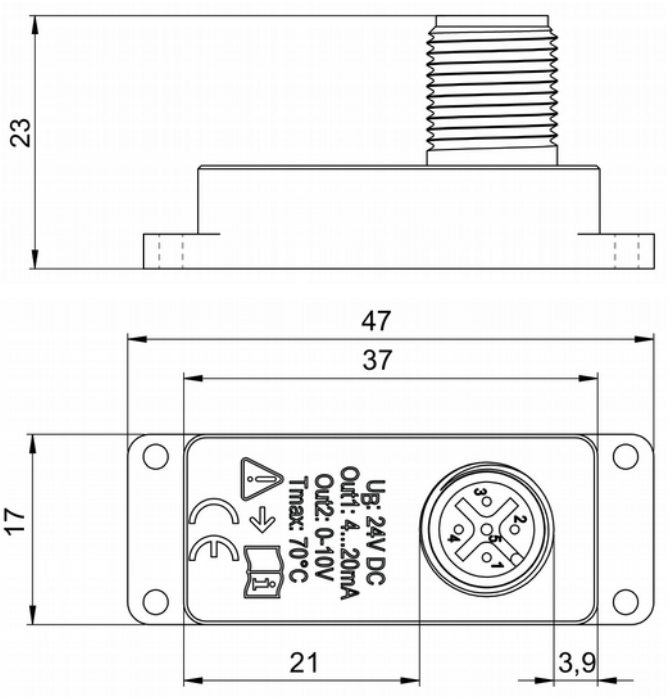
Flowmeter and analogue transmitter SU20 have been optimally adjusted to each other and may not be exchanged.

Electrical Connection:



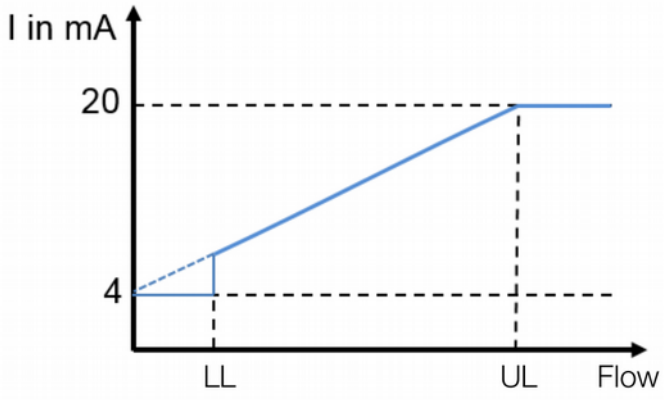
Attention: Pin 5 must not be electrically connected! We strongly recommend use of a four core cable.

Dimensions:

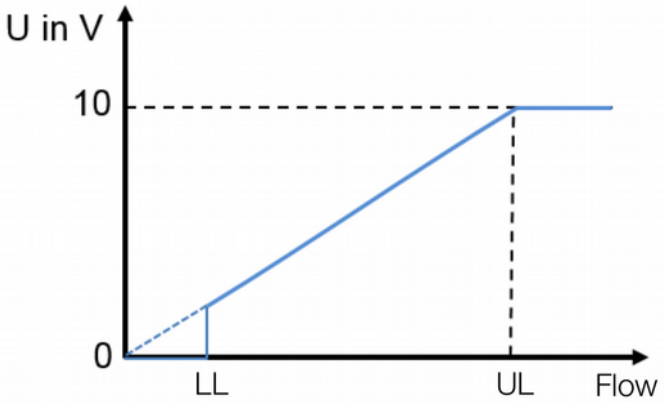


Characteristics:

Current-Flow characteristic:



Voltage-Flow characteristic:



LL: lower limit of measuring range
UL: upper limit of measuring range

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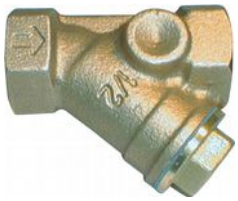
Accessories (see separate data sheets):

- **Needle valves SNV01, SNV02**

- **Ball valves SKG01, SKG02**

- **Dirt traps SF00, SF01**



- **Protection relay MSR01**

- **M12 Plug connector PVC-cable SM12**

Notes:

The specified measuring/switching ranges apply when the instrument is installed vertically and the flow rate is from bottom to top.
Other installation positions or operating densities deviating from the specified specifications increase the specified measuring error.

Special scales for different media and operating conditions are available on request.

The specified switching points are shut-off points at falling flow rates. Please note that the switch-on points are higher due to the hysteresis.

For applications where pressure surges are to be expected, please contact PKP!

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